CASE SUMMARY

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Equistar

EQUISTAR
Clinton, Iowa (Clinton County)

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MAJOR: Chemical Engineering
SCHOOL: Iowa State University

The Company

Lyondell Chemical Company, Millennium Chemicals, and Occidental Petroleum Corporation jointly own Equistar Chemicals. The facility uses ethane and propane feedstock to produce ethylene, which they use to manufacture high and low density polyethylene products.

Project Background

Equistar focused the internship on developing and expanding conceptual ideas for different disposal methods for the maleic anhydride waste stream. Identifying potential alternate source ingredients was also an objective.

Incentives to Change

Equistar will install a new extruder within the next year, resulting in an expected increase in Plexar® production. This would increase both the maleic anhydride waste that is generated and the fresh maleic anhydride that is purchased by Equistar.

Results

Maleic anhydride is a comonomer used in the finishing of Plexar®, a type of high-density polyethylene. A circulation pump keeps the maleic anhydride in the run tank thoroughly mixed, until it can be pumped into the process using a positive displacement pump. The flow rate is monitored by a micromotion mass flowmeter. The molten maleic anhydride and molten polymer are combined in a reactive extrusion process with varying temperature zones.

Various options were explored to decrease the amount of maleic anhydride waste. One alternative is to recycle it as feedstock in the Plexar® finishing process. As a closed loop recycling system, this option would save the company $25,675 in disposal costs for hazardous waste annually. It would provide a cost-savings of an additional $19,000 in purchasing for a total cost savings of $45,000 annually.

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Another option is to change the maleic anhydride into maleic acid. By adding water, Equistar could sell the maleic acid, which is used industrially as a comonomer for unsaturated ploymer resins and other copolymers and as a chemical intermediate for lube oil additives, fumaric acid, agricultural chemicals. This alternative would save $25,675 in disposal costs, plus the selling price for the maleic acid, less the costs of processing and shipping.

In order to analyze whether the maleic anhydride can be reused, a sample of the maleic anhydride from the vacuum tank needed to be tested for purity. The intern researched various laboratories that could do the tests outlined in the procedure.

As a result of design improvements in the new extruder, to be installed within the next year, extruder efficiency will be improved. The amount of waste reduced or raw materials saved cannot be known until the extruder has been installed, but it is estimated that product source reduction could reduce maleic anhydride purchasing by greater than 17,000 pounds.

The intern created a Microsoft® Access hazardous waste storage database of waste from throughout the plant. The new tracking system allows the number of drums to be multiplied by the drum's density conversion factor to obtain the pounds of waste produced for each waste stream on a quarterly basis. Every quarter a sample of waste sludge is tested for the presence of polynuclear aeromatics (PNA). The intern completed a statistical analysis for the total PNA's during the past six years. It included graphs of the total PNA's as a function of time, and rolling averages for the total PNA's against time, along with the averages, standard deviations, and 3-sigma variances for several time periods.

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